Magnetic and structural properties of mass-filtered *3d* transition metal nanoparticles

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Clusters and nanoparticles are not just small pieces of material with physical properties nearly identical to the bulk. Their electronic, optical and magnetic properties are remarkably size-dependent with a non-linear behaviour between the two general limits given by the atomic and the bulk-like behaviour. In particular, strongly enhanced magnetic moments have been found in small *3d* transition metal clusters when compared to the corresponding bulk properties [1]. These findings are mainly due to the reduced coordination of atoms sitting in surface positions. Since the relative contribution of surface atoms strongly decreases with increasing particle size it is expected that larger particles will already show bulk properties. However, recent experiments revealed strongly enhanced magnetic orbital moments in the case of deposited iron nanoparticles consisting of more than 10.000 atoms and thus hint at a remarkable cluster-substrate interaction [1, 2].

In this contribution we present investigations on the magnetic spin and orbital moments of mass-filtered *3d* transition metal nanoparticles with diameters ranging from 4 to 10 nm in contact with different epitaxially ordered surfaces. The crystallographic structure and morphology have been determined independently by means of high resolution transmission electron microscopy (cf. Fig. 1) and scanning tunneling microscopy, respectively. The magnetic spin and orbital moments of the clusters have been obtained from *in situ* measurements of the X-ray magnetic circular dichroism. Comparing the magnetic properties of nanoparticles on different surfaces reveals indeed a strong cluster-substrate interaction and is interpreted in terms of contact-induced strain. Finally, an outlook is given to future investigations on the magnetic moments of individual nanoparticles.

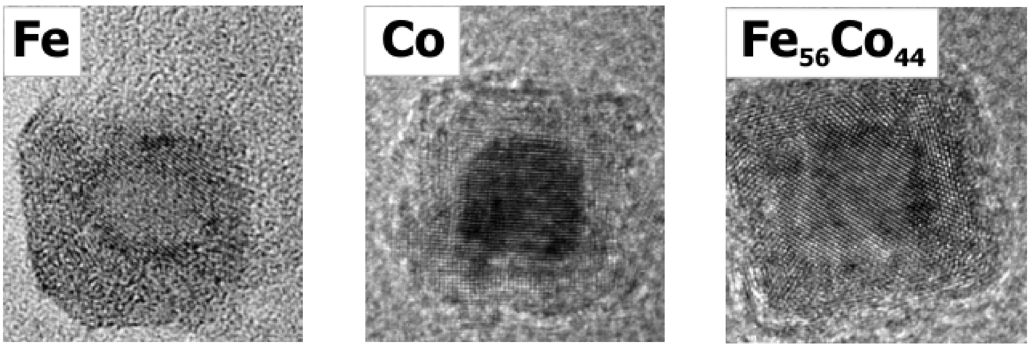

Figure 1. High resolution transmission electron microscopy images of individual nanoparticles with diameters of about 15 nm.

[1] J. Bansmann et al., Surface Science Reports **56**, 189 (2005).
[2] J. Bansmann and A. Kleibert, Appl. Phys. A **80**, 957 (2005).